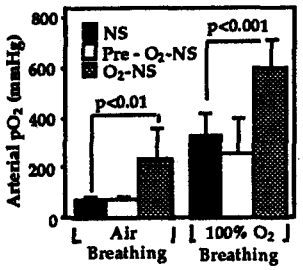

Conclusion: Experimentally, O_2-NS infusion can be used to correct hypoxemia and to produce hyperoxemia without adverse effects.

1014-156 A New Left Atrial Pump Function Operating in High Heart Rate: Atrial Contraction Favorably Induces Early Opening of Mitral Valve in Tachycardia

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In ten open-chest anesthetized dogs we examined the behavior of atrial contraction during "summation" of early and late diastolic transmitral flow (TMF). Progressive increases in heart rate were induced by right atrial pacing after sinus node crash. LV and LA pressures (by micromanometer), TMF (by transesophageal echocardiography), pulmonary venous (PV) flow and cardiac output (CO; by ultrasonic flowmeter) were examined at paced heart rates of 140, 160, 180, 200 and 220 bpm. *Results:* At 180 bpm during incremental changes in paced heart rate, high atrial a wave abruptly appeared in the period of isometric LV relaxation superimposed on the v wave in LA pressure. At that time early diastolic PV reverse flow was observed simultaneously with beginning of TMF, showing that LA contraction, at a time when mitral valve was closed, induced early opening of mitral valve prior to the onset of rapid LV filling. CO was not decreased from a control of 140 to 180 bpm. However, above 200 bpm CO significantly fell below control (1.7 ± 0.4 at 180 bpm $\rightarrow$ 1.2 ± 0.4 L/min at 200 bpm, $p < 0.01$) accompanied with decrease in peak velocity of TMF (50 ± 4 at 180 bpm $\rightarrow$ 29 ± 1 cm/sec at 200 bpm, $p < 0.01$). Above 200 bpm the LA contraction occurred prior to the termination of the preceding LV contraction. *Conclusion:* At 180 bpm CO was maintained in spite of shortened LV diastolic duration. This is because the LA contraction favorably induces early opening of mitral valve, consistent with previous clinical study demonstrating that in tachycardia of dual-chamber pacing the occurrence of LA contraction at isovolumic relaxation phase produced maximum CO due to prolongation of diastolic filling period and accelerated isovolumic relaxation (*load-dependant relaxation*). We might find a new LA function operating in high heart rate.

1014-157 Increase in Renal Blood Flow with External Counterpulsation

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In pts with a low cardiac output, decreased renal blood flow may cause serious complications. The purpose of this study was to evaluate the effect of sequential external counterpulsation (SECP) on renal blood flow. We studied 18 pts (age 55 ± 8; 14 males). All pts had inoperable coronary artery disease and left ventricular dysfunction. Using a portable unit, cuffs were applied to the calves and thighs, inflated sequentially with air at the onset of diastole, and deflated at the onset of systole. Renal duplex scanning was performed during intermittent SECP. Flow velocity (FV) and FV integral (FVI) were measured at baseline and during SECP. The procedure was well tolerated by all pts.

Results: Diastolic augmentation of renal FV was observed in all pts with SECP. The mean FVI increased by 19%, from 21 ± 1 to 25 ± 1 cm ($p = 0.0001$). All pts showed a new diastolic FV wave during SECP, with an average peak velocity of 40 ± 2.5 cm/sec. This diastolic wave was 68% as high as the systolic wave during SECP. In addition the systolic wave increased during SECP by 8%, from 59 ± 3 to 64 ± 4 cm/sec ($p = 0.006$).

Conclusion: SECP increases renal blood flow by a mean of 19%. This noninvasive treatment may be useful to temporarily support pts with decreased renal perfusion.

1014-158 Biochemical and Morphological Responses in Adults And Growing Organisms After Latissimus Dorsi Conditioning For Cardiomyoplasty

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After several weeks of electrical stimulation (ES), adult latissimus dorsi muscle (LDM) acquires increased fatigue resistance. After ES is stopped, the conditioned muscle returns to its initial state. We hypothesized that LDM of a growing organism would have more plasticity and would not revert to its initial state after ES was stopped. ES protocol for 56 days was performed in 4 adult and 4 newborn (5 days old) sheep. Telectronics Myostim 7220 pacing systems were used. Results are summarized below:

	Adult			Lamb		
	Baseline	ES	Delay	Baseline	ES	Delay
LDH-5 (% of total)	96±3	74±4	83±3	91±5	77±8	68±3
LDH-1 + 2 (% of total)	1.2±0.3	8.4±0.4	4.6±0.3	2.5±0.9	6.7±1.9	7.2±1.5
Mitochondrial Area (%)	5.2±2.0	6.9±1.3	5.4±1.3	3.3±0.5	6.5±0.5	5.1±0.4
No. Of Nuclei per mm^2	517±55	994±52	576±47	567±52	1012±7	851±48

In adults, when ES was stopped for 2 weeks (Delay), lactate dehydrogenase (LDH) fraction-5 levels increased after declining during ES. Whereas in lambs, levels continued to decrease after the delay. In adults, LDH fractions-1 + 2 decreased when ES was stopped after having increased during ES. In lambs, LDH-1 + 2 continued to increase after the delay. In adults, mitochondrial area and number of nuclei per mm^2 reverted to baseline when ES was stopped. In lambs, they continued to be elevated as compared to baseline.

After 8 weeks ES, adult LDM lost 7% contractile force during 30 minutes of fatigue testing; 33% force was lost during testing after 2 weeks delay. Lamb LDM lost 7% and 12% respectively.

This data shows that the transformed muscle of the lamb did not revert to baseline levels after a delay period, and if this muscle was trained before cardiomyoplasty it may be used immediately for cardiac assistance.

1014-159 Optimizing Aortomyoplasty Performance Using Muscle Wrap Geometry

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Aortomyoplasty, a new treatment for heart failure, has now been performed in over 20 patients. Current clinical application wraps the latissimus dorsi, en-bloc around the aorta circumferentially (CM). A new wrap geometry was envisioned that divided the distal 10 cm of the muscle longitudinally and wrapped one segment clockwise and the other counterclockwise in a "wringer" fashion (WR) around the descending aorta. We hypothesized that the new wrap would more effectively eject volume from the wrapped aortic segment. The wraps were done in random order in 9 dogs. Left ventricular and aortic pressures, left anterior descending coronary artery blood flow (CoF, ml/min), and aortic blood flow proximal and distal to the muscle-wrapped segment were measured. Mean diastolic aortic pressure (MDAP, mm Hg), endocardial-viability ratio (EVR) and the blood volume ejected from the wrapped aortic segment (WSV, ml) were calculated and are presented as mean ± SEM.

	MDAP	CoF	EVR	WSV
Baseline	97 ± 3	7.4 ± 0.4	1.21 ± 0.03	NA
CM	105 ± 5	8.6 ± 0.9*	1.28 ± 0.06*	3.70 ± 0.64
WR	106 ± 5	9.7 ± 1.2*‡	1.40 ± 0.06*‡	5.24 ± 1.00‡

*$p < 0.05$ compared with baseline, ‡$p < 0.05$ compared with CM.

Muscle wrap geometry determined wrap stroke volume. The wringer configuration ejected more blood from the wrapped segment of aorta than the currently used wrap. Increased wrap ejection favorably influenced CoF and EVR. The "wringer" geometry should be considered for clinical use.

1014-160 Mechanics of the Human Aorta During Intraaortic Balloon Counterpulsation

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To assess mechanics of the aorta during intraaortic balloon counter-pulsation (IABC), clockwise pressure-diameter loops were obtained from the simultaneous recordings of aortic diameter (D) and aortic pressure (P) in 6 pts (age 52 ± 8 yrs) with cardiogenic shock, before (fig. A) and during IABC (fig. B). Aortic Ds were measured just below the left subclavian artery with